Final Report

of

NASA's
International Space Station
Utilization Management Concept Development Study

December 2002

Preface

In response to direction accompanying the FY 2001 and 2002 VA-HUD-Independent Agencies Appropriations Acts (P.L. 106-377 and P.L. 107-73, respectively), NASA undertook, in March 2002, an International Space Station (ISS) Utilization Management Concept Development Study. The Study drew upon a series of previous assessments, and examined, in detail, various management options for the utilization of the ISS. The result of the study is the following report.

NASA has defined the fundamental objectives of ISS utilization management as follows:

- to facilitate the pursuit of flight research;
- to optimize research opportunities within current capabilities of ISS and with future enhancements for greater capabilities; and,
- to increase the long-range productivity of science, technology, and commercial research and development aboard the ISS.

The ISS Utilization Management Concept Development Study examined a full range of options for utilization management and evaluated them against criteria aligned with the objectives identified for ISS utilization management. The management options ranged from NASA's retaining all ISS utilization functions within the Agency, to establishing an independent Government corporation fully responsible for utilization management. This report presents the process used during the study for consideration of various management options and the decision-making process used by the study team to develop a final recommendation on the best option. The recommendation of the study is the establishment of a non-governmental organization, specifically a Non-Profit Institute, to perform research leadership functions for the ISS, including significant aspects of research planning, research payload manifesting, resource allocation, advocacy, outreach, and archiving. Based upon the recommendation, NASA plans to formulate a detailed implementation plan to be submitted to Congress in mid-2003, consistent with direction included in the FY 2000-2002 NASA Authorization Act (P.L. 106-391).

This report was prepared by NASA's ISS Utilization Management Concept Development Team, under the direction of NASA's Biological and Physical Research Enterprise. The team was comprised of representatives from NASA Headquarters and each NASA Center involved in ISS utilization. It is intended to be of interest to Congress, the ISS user community, and potential offerors for an ISS Non-Government Organization.

Executive Summary
Report
of
NASA's
International Space Station
Utilization Management Concept Development Study

In compliance with direction accompanying the FY 2001 and FY 2002 VA-HUD-Independent Agencies Appropriations Acts (P.L. 106-377 and P.L. 107-73, respectively), NASA has completed a comprehensive study of ISS utilization management options, and developed this report with a recommended management approach.

The study was a seven-month, inter-Center team assessment of options for ISS utilization management. The study set the following objectives for ISS utilization management:

- to facilitate the pursuit of flight research;
- to optimize research opportunities within current capabilities of ISS and with future enhancements for greater capabilities; and,
- to increase the long-range productivity of science, technology, and commercial research and development aboard the ISS.

The Study recommends the establishment of a non-governmental organization, specifically a Non-Profit Institute, to perform research leadership functions for the ISS, which will maximize return of science results, advanced technologies, and commercial applications. This recommendation is based on a thorough qualitative and quantitative analysis of the study results and extensive discussions with senior managers across the Agency. Building upon the recommendations in this report, NASA plans to develop a detailed implementation plan, which will be submitted to Congress in mid-2003, consistent with guidance included in the FY 2000-2002 NASA Authorization Act (P.L. 106-391).

The Non-Profit Institute was determined to be the most effective of 10 business models that were evaluated. Most of these models were identified by an earlier industry study on ISS utilization commissioned by NASA. NASA's Space Telescope Science Institute, with a combined staff of 500 persons responsible for operating the Hubble Space Telescope, also provided a model of success for non-profit institutes developed for large U.S. Government science organizations. Past NASA experience with successful user community-focused organizations, such as the Space Telescope Science Institute, has demonstrated that these types of organizations can lead to more efficient and effective research utilization. A scoring process, based on measurable evaluation criteria resulted in the emergence of the research institute as the preferred business model.

As a key part of the NASA study, the scope of utilization work was defined as 21 principal functions, ranging from development of strategic plans to archiving of research samples. A few functions, such as policy development and safety certification, were

determined to be inherently governmental. The other functions were candidates for delegation to a non-governmental organization.

In parallel, an internal NASA reinvention effort has been initiated to identify and implement organizational or process changes across the ISS and shuttle programs that can strengthen NASA and remove impediments to space utilization. After completing the NASA reinvention effort, NASA will retain the option to compete a Phase 2 contract to delegate more utilization management functions to the Non-Profit Institute. These delegated functions could include additional aspects of utilization mission management, research payload analytical integration, research payload operations integration, and expanded responsibilities for maintaining and sustaining research payload-related flight and ground systems.

As a result, a two-phase contracting approach is recommended. A Phase 1 contract will be implemented concurrently with NASA reinvention, and will focus on science, technology, and commercial (S/T/C) leadership functions. Should NASA management decide to implement the Phase 2 contract, it will maintain the S/T/C leadership focus, and add responsibility for additional utilization management functions. Factors influencing a potential future decision to delegate more utilization management functions to a Non-Profit Institute include the importance of maintaining an institute focus on the S/T/C leadership functions, the need to clearly establish requirements for the additional utilization management functions, and the conclusion, based upon past experience, that a single entity should ultimately have the end-to-end authority and accountability for the competitively sourced functions for multiple reasons including efficiency, safety, and simplification of interfaces. If NASA makes the determination, in the future, to pursue Phase 2 to delegate additional functions to the Institute, the Agency will consult fully with the Congress, in advance of implementation.

The potential bidder community will be fully informed of NASA's intentions from the beginning and will be provided with an opportunity to submit feedback on the recommended approach prior to the release of a Request for Proposals (RFP).

Report

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Introduction

The ISS represents a valuable asset to the Nation, and is demonstrating the potential for a promising return, in the future, as continuously operating laboratories, observatories and test beds are established in low-Earth orbit. In response to direction accompanying the FY 2001 and FY 2002 VA-HUD-Independent Agencies Appropriations Acts (P.L. 106-377 and P.L. 107-73, respectively), NASA undertook an ISS Utilization Management Concept Development Study, which involved a comprehensive study of ISS utilization management options. This report documents the process for, and resulting recommendation of, that study. The study recommends the establishment of a non-profit organization, specifically a Non-Profit Institute, to perform research leadership functions for the ISS, including significant aspects of research planning, research payload manifesting, resource allocation, advocacy, outreach, and archiving.

Leading up to the recommendation to proceed with the Non-Profit Institute, NASA has conducted or contracted for several studies of management options for ISS utilization over the last several years. These studies led to the following recurring themes, which have contributed to the selection of a Non-Profit Institute as the recommended management option:

- The ISS research community should have early, substantive, and continued involvement in all phases of the planning, design, and implementation of research.
- NASA must engage the research community in a cooperative endeavor to aggressively expand the scientific foundation for human exploration and the development of space.
- NASA must be able to minimize the separation between the research community and the ISS program and provide a user-friendly environment that enables faster, simpler access to the resources available to accomplish the research mission.

In addition, ongoing dialogue with the user communities revealed certain recurring perceptions concerning management of ISS research. These perceptions indicated that NASA could improve or better communicate its performance in the following areas: commitment to the ISS as a world class international research facility; science leadership and accountability to users; standardization; responsiveness to user inputs; ability to make experiment modifications during flight; and enabling opportunities for multiple experiments in a single mission.

To achieve the promise of the ISS as a national and international asset, NASA is convinced that the Agency must move out quickly to address user community concerns. NASA must minimize the separation between the research community and the ISS program, and provide a user-friendly environment that enables faster, simpler access to the resources available to accomplish the research mission. NASA seeks to enable high-quality, more timely, research results in order to improve research overall. NASA believes that the work of a successful Non-Profit Institute will address these concerns and lead to the scientific results the Agency envisions.

Background

As noted, management options for ISS utilization have been extensively studied over the last five years. Prior to the ISS Utilization Management Concept Development Study, NASA had commissioned four external studies and one internal study[1]. The four external studies were completed during the FY 1999–2002 timeframe, and were designed to obtain objective recommendations from the science and engineering communities. The internal study, conducted in FY 2000, defined the scope of functionality associated with ISS utilization management. Each effort resulted in a final report that is available in the public domain.[2]

The ISS Utilization Management Concept Development Study, initiated in March 2002, was conducted by representatives of each NASA Center responsible for ISS utilization, who were directed to build upon the earlier studies. Team members were selected based upon direct experience with the ISS utilization process.

The charter of this ISS Utilization Management Concept Development Team was to:

- characterize the current Agency ISS utilization processes, organizational interfaces, and management framework[3];
- identify inherently governmental functions within the ISS utilization processes;
- assess the advantages and disadvantages of various management approaches to ISS utilization;
- recommend NASA process and/or organization changes/reforms;
- identify implications for workforce transition and/or skill mix rebalancing; and,
- provide a detailed evaluation of the most viable options for alternative ISS utilization management approaches.

The seven-month internal NASA study was completed in September 2002. To understand the study results, provided below is a summary of the process employed by the NASA Team to develop and evaluate alternative ISS utilization management options. The study also provides a recommendation for the most effective course of action to improve ISS utilization management.

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[1] Further information on the first five studies may be found in Appendix A.
[2] http://spaceresearch.nasa.gov/research_projects/ngo.html
[3] A discussion of the ISS Utilization Management Baseline may be found in Appendix B.

Formulation Period and Study Process

As mentioned, the NASA Team reviewed the findings of all prior internal and external studies and used this information as a foundation for its study. The team also obtained current information on all aspects of budget and workforce planning for ISS utilization through the established Program Operating Plan 2002 process. Team sessions were structured to:

(1) capture the essential data;
(2) characterize the scope and complexity of ISS utilization;
(3) develop the fullest conceivable and feasible range of options;
(4) analyze all critical aspects of these options from a systems engineering perspective; and
(5) evaluate the feasibility, practicality, and implications of the options to the Agency.

In order to incorporate independent, constructive critique to the NASA Team study, a series of reviews were conducted by three separate groups of NASA senior managers:

(1) One group of managers focused on the process, schedule, and forward action plan utilized by the NASA Team, ensuring thorough consideration of the program complexities and the validity of the technical accuracy, completeness, and viability;
(2) A second group focused on the model outcomes and the corresponding implications of each option on Agency budget, civil service and contractor workforce, competencies, and facilities; and,
(3) The last group examined the option evaluation methodology used by the NASA Team, thereby ensuring objectivity, analytical rigor, and NASA confidence in the conclusions.

In addition, reviews by the NASA Center Directors played a key role in critiquing the study processes and products.

Building upon the senior management and Center Director reviews, periodic status briefings were scheduled with existing Agency management organizations, such as the NASA Enterprise Council and ISS Program leadership, to further analyze the results of the study and begin to gain consensus on the recommended option to be selected. These briefings served to inform the NASA management of the work underway and to invite their viewpoints on alternative options for ISS utilization management.

To incorporate the perspectives of the external user community, the NASA Team held an open User Workshop midway through the study process. Announcements were broadly circulated in order to encourage the widest possible participation, and the meeting was structured to obtain feedback regarding perceptions arising from participant experiences in ISS utilization missions.

The NASA Team also sought to understand the perspectives of the internal ISS utilization community during the formulation and study process. Subject matter experts were interviewed to enhance understanding of the complexity of the ISS utilization processes. These experts provided information essential for the success of the study. They also conducted periodic reviews throughout the course of the study to ensure accuracy and completeness.

The general approach outlined above was developed during the formulation period as the NASA Team organized their effort and planned key products. The Senior Management review concentrated attention on this approach and resolved the detailed process for a study encompassing eight critical tasks. The relationship between each task is depicted in Figure 1. This process represents the backbone of the effort, and is summarized in the following pages with reference to the detailed products and outcomes of the NASA Team. This report and the associated products will be made available in the public domain.

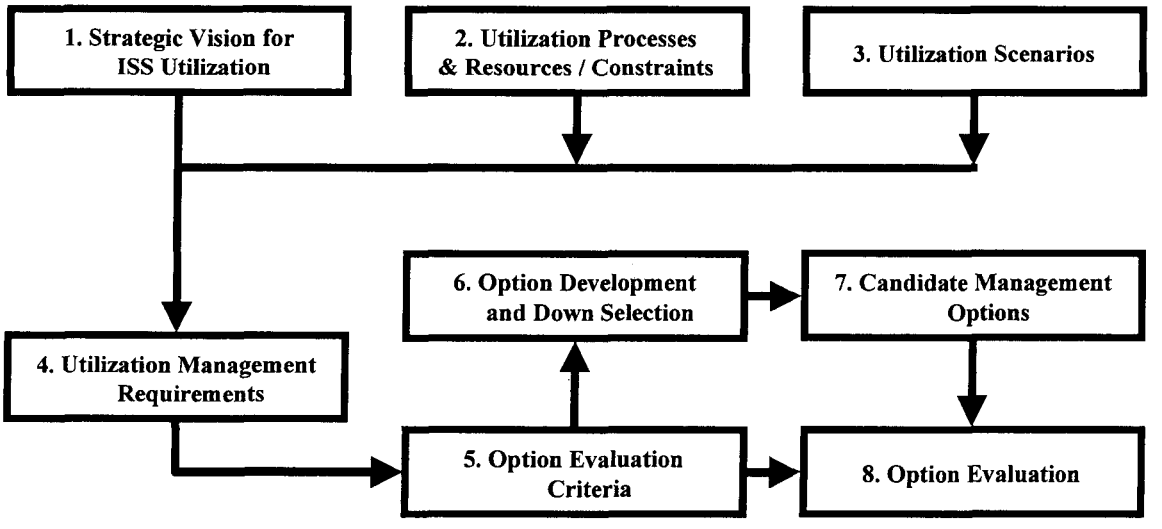
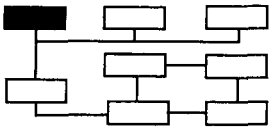


Figure 1: Study Process



Task 1: Strategic Vision for ISS Utilization

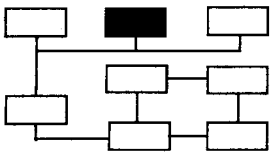
The ISS represents our human outpost in space and brings nations together for the benefit of life on earth – and beyond.

This Strategic Vision was formulated under the leadership of the Associate Administrator for Biological and Physical Research, and collectively refined by members of the NASA

Enterprise Council. The vision was later briefed to the community at large during the User Workshop, and further comment was solicited. NASA recognizes that research aboard the ISS will address many spheres of endeavor, and must be aligned with and responsive to the strategic plans of the research sponsors[4]. The Strategic Vision for ISS Utilization formed the point of departure for the latest study.

Underlying the Strategic Vision, NASA developed a set of Guiding Principles, which provided the foundation for identifying organizational objectives for ISS utilization management. These principles were drafted and refined in parallel with the formulation of the Strategic Vision, and addressed aspects such as: the need for balance and diversity in the research portfolio; substantive and continuing involvement of the user community; the highest quality and integrity in research selection processes; simplification and streamlining of utilization procedures; and flexibility and adaptability in the research objectives over time. Many of these principles echoed the findings of the prior study by the National Research Council, Institutional Arrangements for Space Station Research.

Building upon the vision and guiding principles, the NASA Team refined and endorsed the following Organization Objectives for ISS Utilization Management:
to facilitate the pursuit of flight research;
to optimize research opportunities within current capabilities of ISS and with future enhancements for greater capabilities; and,
to increase the long-range productivity of science, technology, and commercial (S/T/C) research and development aboard the ISS.



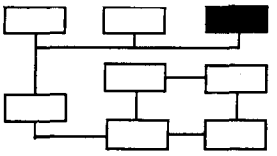
Task 2: Utilization Processes, Resources, and Constraints

The NASA Team then sought to identify the range of Agency Policies, Procedures, and Agreements that constrains the current baseline program, and which could be affected by a change in the approach to ISS utilization management. The NASA Team developed an inventory of these constraints based on existing ISS utilization documentation and established practices. This inventory contributed to study results that further characterized the complexity of ISS utilization, and were specifically applied to a series of flow diagrams depicting current functional interfaces.

The NASA Team then considered the projected availability of ISS user facilities and resources. While the current plan for the International Partner Core Complete Station was used as a reference point, the results are premised on an ISS that will operate for at least another decade (i.e., the design lifetime), and potentially much longer, based on experience with prior human-rated spacecraft. As a result, the current projection for user physical accommodations and resources was not viewed as a hard constraint in the long term. Instead, it was envisioned that an alternative utilization management approach

[4] The complete text of the Strategic Vision for ISS Utilization is available in Appendix C.

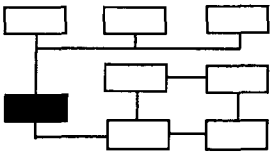
could maximize use of near-term capabilities and achieve the productivity gains made possible by the future growth of ISS capabilities.



Task 3: Utilization Scenarios

The complexity of diverse research operations conducted on-board the ISS, along with physical interfaces to, and functional dependencies upon, the ISS itself, transportation vehicles, and crew, add to the complexities of ISS utilization management. Each research investigation presents unique challenges to the management organization. To ensure these challenges are addressed, the NASA Team assembled a representative sample of Payload Scenarios for consideration during the option development studies.

The Team also distinguished scientific, technological and commercial requirements corresponding to each of the major areas of research endeavor. Similarities and dissimilarities were characterized to ensure that subsequent efforts fully addressed the unique aspects of each area and accommodated the diversity inherent in a balanced research portfolio.



Task 4: Utilization Management Requirements

A key activity of the NASA Team was resolution of the principal ISS utilization functions and corresponding definitions to characterize the full scope of work associated with ISS utilization. A series of 21 functions resulted, which were then further delineated.[5] This Functional Detail expanded the full depth of activities encompassed by each function. At this lowest level of detail, "inherently governmental"[6] activities were identified through consultations with legal and procurement experts. "Appropriately NASA-led" activities were also identified in order to classify those aspects of mission safety assurance and physical integration that, although outside the definition of "inherent," were considered to be NASA governmental responsibilities.

This functional detail led to the development of performance targets and criteria by which to evaluate and measure the effectiveness of any ISS utilization management organization. The result was a set of safety, performance, and business targets, which could be employed to gauge progress toward meeting the vision for ISS utilization within the context of the guiding principles. This detail produced a mix of quantitative and

[5] Descriptions of the 21 principal functions can be found in Appendix D.

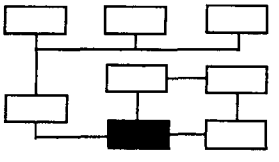
[6] OFPP Policy Letter 92-1 was used to identify "inherently governmental" activities of ISS Utilization Management; procurement experts involved in FAIR Act Inventory were asked to review NASA Team findings.

qualitative factors and specific supporting criteria that were regularly revisited during the course of the study.

The User Workshop was conducted to encourage the user community at large to share their perspectives on the ISS utilization management requirements. Both users and interested industry representatives attended the Workshop. The ISS user community includes science, technology, and commercial researchers. The ISS science community is the largest of the three components, and includes researchers from universities and government in a wide variety of science disciplines. The majority of the members of these research communities have extensive experience with spaceflight experiments on the Shuttle and earlier space vehicles, and are successful managers of science and technology projects on the ground and in space.

The principal functions were distributed to the participants, who were requested to evaluate their experience with respect to each of these functions. The *Report of the User Workshop on Utilization Management Concept Development for the ISS*, containing the findings of four working groups and a statistical summary of the participants, was posted to the public domain following the proceedings.[7]

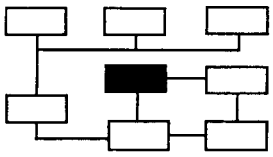
The results of the User Workshop, along with previous customer surveys, resulted in a summary of recurring inputs from the ISS user community. This information focused attention on program strengths and weaknesses for the benefit of all study participants and subsequent reviewers.



Task 5: Option Evaluation Criteria

Evaluation criteria were then developed in preparation for the down-selection of the management options. A preliminary set of criteria was produced, each criterion was refined, and additional criteria were added as insights were gained during the balance of the study. Linkage to the Strategic Vision, Guiding Principles, Organization Objectives, and Recurring Inputs from the ISS User Community was key in the development of the descriptive narrative for each criterion. The review by key NASA Center Directors advanced the maturity of the evaluation criteria, and the final Senior Management review was employed to independently validate the breadth and scope of the final set of evaluation factors. The evaluation criteria were then finalized.

[7] http://spaceresearch.nasa.gov/research_projects/ngo.html



Task 6: Option Development and Down-Selection

a. Option Development

The complete set of available options was then defined. **The NASA Team first partitioned the Principal Functions identified in Task 4 into eight Functional Models. Model A would not move any functions out of NASA, but would institute management improvements. Models B through H represent progressively larger subsets of ISS utilization functions that potentially could be transferred out of NASA to a new organization.** These models were:

A. NASA continuous improvement
B. S/T/C leadership functions
C. Model "B" + sustaining payloads
D. Model "C" + developing payloads
E. Model "D" + mission management/operations
F. Model "E" + payload engineering
G. Model "B" + mission management/operations
H. Model "G" + payload engineering

Model "A" represents a continuation of the NASA continuous improvement process currently underway (i.e., the baseline) and did not include any new operational entities.

Model "B" represents a transfer of the subset of functions most closely aligned with Science, Technology, and Commercial (S/T/C) research leadership to a new operational entity.

Models "C" through "F" represent a progressive buildup in functions transferred to a new operational entity. Each subsequent model takes the precedent model and adds a subset of functions.

Model "G" represents a combination of the research leadership functions in Model "B" with the research mission management and integrated research operations functions for transfer to a new operational entity.

Model "H" builds upon Model "G" by adding the payload engineering functions for transfer to a new operational entity.

After identifying a full range of functional models for consideration and analysis, **the NASA Team identified a full range of Business Models[8] through which the new**

[8] In the context of this report a business model refers to any organizational entity, not necessarily a commercial company.

entity could be formed, using as its basis a NASA contracted report, *"Options for Managing Space Station Utilization,"* by the Swales Aerospace Company. In 1999, NASA requested a current support contractor, Swales, to study potential business models for an NGO to manage the utilization of the U.S. elements of ISS. The NASA Team augmented the Swales report by including a Federally Funded Research and Development Center and a restructured NASA organization as candidate business models for the management of ISS utilization. The full set of business models the NASA Team considered were:

1. For-profit Contract
2. Non-profit Contract Institute
3. Cooperative Agreement
4. Space Act Agreement
5. State Government Corporation
6. Federal Government Corporation
7. Cooperative Association
8. Government Sponsored Enterprise
9. Restructured NASA Organization
10. Federally Funded Research and Development Center

b. Selection of Candidate Options for Development

To perform the down-selection of potential options, the NASA Team arrayed the eight functional models against the ten business models for evaluation and down-selection purposes. Evaluation of the options reduced the option matrix field from the 80 possible combinations. Of the 80 possible options, 58 combinations were eliminated:

- 16 combinations were immediately eliminated because they combined an NGO business model with a functional model in which NASA performed all the functions. The restructured NASA organization option was preserved for NASA to continue managing all functions;

- 14 combinations were eliminated, which corresponded to cooperative agreements and cooperative associations, because they did not represent binding agreements through which the government could ensure accountability of performance;

- Seven combinations, which related to use of a Space Act agreement, were eliminated because NASA does not provide funding in such agreements, and it is clear the operating entity will require appropriated funds for the foreseeable future;

- Seven combinations, which related to government sponsored enterprises involving privately owned assets, were eliminated because it is clear that ownership of the ISS is not suitable for transfer in the foreseeable future due to its role as an integrated, international facility;

- Seven combinations, which related to state corporations, were eliminated in consideration of the potential for state and federal conflict; and,

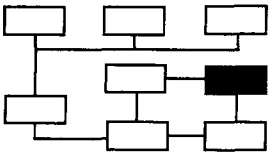
- Seven combinations, which related to for-profit contracts, were eliminated due to the perceived conflict of interest between the profit motive and the research leadership role.

After the first round of eliminations, 22 possible function/business model combinations remained viable for consideration. These remaining functional/business model combinations included only the following four business options:

- **Non-Profit Institute Option** - An organization devoted to research, the development and transfer of technology, and the provision of service to the scientific community and the public (e.g. NASA's Space Telescope Science Institute). The organization facilitates scientific and industrial community access to the ISS (established under NASA Procedures and Guidelines 5000.1, entitled "Establishing a Science And Research Institute");
- **Federal Government Corporation Option** - An organization that combines the flexibility of a business with the public purpose and public duties of a traditional governmental organization (e.g. Amtrak). The authority to charter a Federal Government Corporation derives from the Necessary and Proper Clause of the U.S. Constitution (established under provisions of the Government Corporation Control Act);
- **Federally Funded Research and Development Center (FFRDC) Option** - An organization that assists the U.S. Government with scientific research and analysis, systems development, and systems acquisition.(e.g. Jet Propulsion Lab). FFRDCs bring together the expertise and outlook of government, industry, and academia to solve complex technical problems that cannot be solved by any one group alone (established under Federal Acquisition Regulation (FAR) Section 35.017: Federally Funded Research and Development Centers); and,
- **NASA Reinvention Option** – Starting from the current continuous improvement baseline, a new NASA Enterprise that builds upon the current organizational and management structure to focus all activities within one centralized organization, and thus provides better response to the research community. The NASA Reinvention model addresses ISS utilization management by a more extensive NASA reorganization or realignment of functions than continuous improvement.

It was not feasible to proceed with 22 options because of the detailed budget and workforce data analyses needed to accompany each option to adequately characterize the implications to the Agency. Therefore, the NASA Team elected to break into four sub-teams corresponding to the four remaining business models. Each sub-team was directed to recommend only one functional model that "best fit" the team's assigned business model, based on the team's analysis. The four sub-teams then assessed the strengths and weaknesses of their recommended functional/business combination model. These functional/business combination models became the following four management options: Non-Profit Institute, Federal Government Corporation, FFRDC, and NASA Reinvention.

While the same option nomenclature was used for both the functional/business combination models and four remaining business models, the "management" options discussed for the remainder of the report included both functional and business components.



Task 7: Candidate Management Options

Each of the four selected management options was analyzed and defined to develop the following:

- **Definition and End-State Description** - provides an overall summary of the option;
- **End-State Functional Table** - identifies the specific principal functions, and sub-functions where appropriate, for which the selected organization would take the lead;
- **Distinguishing Characteristics** - provides the rationale, role, and scope of the selected organization;
- **Legal Structure** - legal instruments that would be employed to establish and maintain the selected organization;
- **Management Structure and Interfaces** - documents the proposed organizational structure and internal and external relationships;
- **Transition Strategy** - illustrates the complexities associated with transition of functions to the selected organization;
- **Option-Specific Strategies** - identifies key aspects of relationships among NASA organizations, other U.S. government entities, International Partners, end-users, and payload developers; and,
- **Implications for Existing ISS Utilization Resources** – analysis of potential workforce, competency, and budget re-distribution.

The NASA Team qualitatively assessed the effects of each management option on Agency budget, workforce, competencies, and ground facility operations and maintenance[9]. NASA Senior Management then reviewed these outcomes and implications. At the suggestion of these Senior Managers, further analysis of competency effects will be undertaken in coordination with the on-going Agency study in this area.

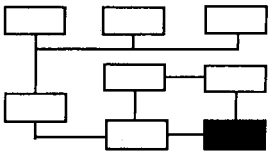
To build consensus across the Agency, the Associate Administrator for Biological and Physical Research requested that the key NASA Center Directors review the ISS Utilization Management study results. They concluded that the following additional steps should be taken regardless of the management option selected:

[9] NASA allocated budget and workforce based on the 21 ISS Utilization functions for the purposes of model development and cross comparison of options. This data was considered sufficient only for purposes of estimation and analyses.

- The original NASA Reinvention option, developed by the NASA Team, which involved a structural reorganization, was not suited to address broader Agency issues that impact ISS utilization. However, some type of NASA reinvention is required to address broader issues across the Agency that affect ISS utilization, regardless of implementing any other option. This must be initiated in parallel with selection and implementation of a utilization management organization. The reinvention effort should be defined, managed, and implemented at the Senior Agency Management level.[10]
- The Government Corporation option was deemed to be premature, and should be removed from further consideration at this time.
- The Agency must move out quickly to address user community concerns.
- A rigorous scoring methodology should be used to evaluate and assess the candidate options.

These additional requirements were then built into the management option selection process.

A summary of the remaining three options (Reinvent, Institute, and FFRDC) is provided in Appendix E.



Task 8: Option Evaluation

The NASA Team developed a Cross-Option Summary Comparison Matrix that summarized the distinguishing characteristics of the options. This matrix provided a high-level comparison of factors across the options, and was reviewed by the NASA Center Directors. In order to implement a rigorous scoring methodology to evaluate and assess the options, the NASA Team then weighted the evaluation criteria, scored the options, and provided the rationale for the scoring.

A series of 18 well-defined evaluation criteria were established to measure the performance potential of each option. The Center Directors recommended adding an additional scoring category to evaluate implications of each option for the Agency. These new criteria addressed the impact of each option beyond its ability to meet performance objectives. The entire set of evaluation criteria was also partitioned into four categories: (1) safety; (2) technical performance; (3) business performance; and, (4) implications. The complete list of the final evaluation criteria is shown in Table 3.[11]

[10] NASA is currently pursuing the reinvention effort at the Senior Agency level.

[11] The descriptive wording of the evaluation criteria is attached in Appendix F.

Safety

1. Safety Assurances

Technical Performance

2. Leadership Commitment - Science
3. Leadership Commitment - Technology
4. Leadership Commitment - Commercial
5. Leadership Commitment - Integrated S/T/C
6. International Involvement
7. Quality of Human Resources
8. Strategic Focus
9. Responsiveness
10. Optimized Use of Access and Resources
11. Shorter Time to Enable Discovery

Business Performance

12. Customer Focus
13. Performance Accountability
14. Integrity
15. Knowledge
16. Interface Responsibilities
17. Financial Expenditure
18. Funding and Support Advocacy

Implications to NASA

19. Transition
20. Establishment
21. Facilities
22. Control
23. Human Capital
24. Competencies

Table 3: Evaluation Criteria

The NASA Team scored the NASA Reinvent (as originally developed by the NASA Team), Non-Profit Institute, and FFRDC options. The original NASA Reinvent option was scored for comparison purposes only, given the fact that the Center Directors had already indicated that the option, as originally developed, required a broader scope and further attention by Agency Senior Management. The Government Corporation was not scored, based on the Center Directors' decision to remove it from further consideration. The NASA Team scored the options based on consensus agreement and documented the rationale for each score.

Weights were applied to the raw scores and the resultant summary is provided in Figure The safety, technical performance, and business performance categories were treated as potential benefits, and their scores were summed for a total benefit. The scores for the implications criteria were summed separately. Through this approach a total benefits versus implications ratio resulted. This ratio was converted into a qualitative expression for a bottom line assessment. The original NASA Reinvent score reflected a low qualitative value to NASA. The Institute option score reflected a high qualitative value to NASA. The FFRDC score reflected a medium qualitative value to NASA.

		Evaluation Criteria	Reinvent	Institute	FFRDC
Safety	1	Safety Assurances	0	0	0
Technical Performance	2	Science Leadership Commitment	0	20	10
	3	Technology Leadership Commitment	20	10	20
	4	Commercial Leadership Commitment	10	10	10
	5	Integrated S/T/C Leadership Commitment	0	10	10
	8	Strategic Focus	0	3	3
	10	Optimized Use of Access and Resources	0	10	10
	11	Shorter Time to Enable Discovery	0	7	7
	12	Customer Focus	0	20	10
	15	Knowledge	0	7	7
		Subtotal	30	97	87
Programmatic Performance	6	International Involvement	6	0	3
	7	Quality of Human Resources	-7	7	7
	9	Responsiveness	7	7	7
	13	Performance Accountability	0	0	0
	14	Integrity	0	0	0
	16	Interface Responsibilities	6	3	0
	17	Financial Expenditure	-3	0	0
	18	Funding and Support Advocacy	-7	7	7
		Subtotal	2	24	24
		Total Benefit	32	121	111
Implementation	19	Transition	20	0	-10
	20	Establishment	7	0	-7
	21	Facilities	3	-3	-3
	22	Control	10	0	0
	23	Human Capital	3	0	0
	24	Competencies	7	0	-7
		Total Implication	50	-3	-27
		Total Benefit vs. Implication	32 : 50	121 : -3	111 : -27
		Qualitative Value to NASA	Low	High	Medium

10 Critical
7 Important
3 Should be Considered

Figure 2: Weighted Scoring of Evaluation Criteria

NASA Senior Management reviewed the process and results of the final evaluation. They determined that there were no obvious errors with the NASA Team conclusions. Senior Management noted the need for an action plan designed to remove the impediments that might prevent either an Institute or FFRDC from fully succeeding.

The final evaluation results and Senior Management recommendations were reviewed with the Center Directors and the NASA Enterprise Council. These results clearly determined that the Non-Profit Institute was the best option to pursue; specifically, in the interests of quickly responding to, and engaging with, the user community, as well as balancing the Institute benefits versus the potential negative impacts during the ISS assembly timeframe.

Recommendation

As a result of the ISS Utilization Management Concept Development Study, **it is recommended that NASA proceed with a competitive sourcing to contract with a Non-Profit Institute to lead ISS scientific, technology, and commercial research.** The Institute leadership role would include the following responsibilities:

- Supporting strategic planning and implementing appropriate strategic plans;

- Formulating and implementing budgets along with costs, schedule, and risk;
- Advocating research and supporting the solicitation, selection, and prioritization process[12];
- Developing advanced concepts for new research initiatives;
- Managing Guest Investigator programs[13];
- Manifesting and resource allocations;
- Providing outreach and education services to the public and industry;
- Recommending and implementing ISS process improvements;
- Managing data archival; and,
- Actively engaging in competitively awarded research.

NASA will ensure that the Institute is staffed with experienced managers who have extensive research experience coupled with solid managerial skills. The staff will be required to provide a solid research base in a diverse set of research disciplines in the three utilization areas: science, technology, and commercial.

The Institute contract start could occur at the beginning of FY 2005, at the earliest. If begun in the fall of 2004, the transition of functions would gradually proceed through 2008. The transition of work is intended to take place as a time-phased series of transitions. Regardless of start date, the Institute would need to demonstrate its ability to assume leadership for each set of ISS utilization functions before any transfer from NASA could occur. As the lead role for a set of functions transitions, the Institute would begin demonstrating the competency to manage the next set of functions. By the end of FY 2008, the Institute would assume complete responsibility for its assigned work.

The workforce and budget estimates, which form the basis for the ISS utilization management option, are based on NASA's budget submit to Congress for FY 2003-2007. The primary value of the workforce and budget estimates used for the Institute was for purposes of evaluation across the options, and should be considered in that context. The estimates, which are limited by the available data, do not include the complete scope of Institute responsibilities expected at the end of the transition period in FY 2008. In addition, these estimates do not reflect the budget and workforce associated with managing Guest Investigator programs. This component of the estimate will depend on the amount of research OBPR identifies for the Guest Investigator programs.

If instituted in FY 2005, the projected initial ramp up year, the Institute is estimated to require a workforce of approximately 75 and a budget of approximately $15 million. Roughly half of the budget is additional funds required for ramp up and transition. By FY 2007, the Institute is estimated to grow to a workforce of approximately 350 and a budget of approximately $90 million.

Additionally, NASA Senior Management has recommended that NASA consider, at the appropriate time, expanding the scope of the Institute to include additional utilization management functions, which may include additional research payload

[o] Overall strategic direction and prioritization of research will continue to be a NASA function.
[13] A description of Guest Investigator Programs is provided in Appendix E.

mission management, research payload analytical integration, and integrated, research payload operations. Safety and certification of flight readiness to the ISS program would remain within the purview of NASA.

Considerations of the approach and timing for adding additional utilization management functions include: the importance of maintaining an Institute focus on the S/T/C leadership functions; the concern that it will be difficult to clearly establish requirements for the additional utilization management functions prior to completing the NASA reinvention effort; and a logical assessment that a single management organization should ultimately have the end-to-end authority and accountability for the competitively sourced ISS utilization functions. Maintaining a research-driven ISS program is appreciably enhanced if all ISS utilization functions not performed by NASA are controlled by one science/technology/ commercial (S/T/C) organization.

Extensive discussions were held by NASA senior managers concerning alternative approaches to address these considerations, which resulted in a recommendation to proceed with a two-phase contracting approach for the Institute. The Phase 1 contract would establish a Non-Profit Institute focused on the S/T/C leadership functions as described above. If pursued, a Phase 2 contract would involve a recompetition for the Institute that would maintain the S/T/C leadership focus, while transitioning additional utilization functions the Agency chooses to include, following the internal NASA Reinvention effort. Although this two-phase approach extends the full transition time to include two competitions, it provides the following benefits:

- focused attention to the S/T/C leadership functions for the Phase 1 effort;
- the opportunity for a Phase 2 refinement of the requirements associated with these functions, based on lessons learned in Phase 1;
- consideration of the results of the NASA reinvention effort in determining the requirements for utilization management functions to be transferred in Phase 2; and,
- addressing the concern that a single entity ultimately have the end-to-end authority and accountability for the competitively sourced functions.

In order to provide notice to the bidder community, NASA will articulate, at the time the Agency issues the Phase 1 solicitation, the Agency's option to decide in the future to compete a Phase 2 contract. This will allow the bidder community to prepare for both. NASA believes that the duration of the Phase 1 contract should be for not less than three years in order to attract Phase 1 offerors, allow Phase 1 performance to stabilize, and incorporate lessons learned from Phase 1 into a Phase 2.

For purposes of estimating the workforce and budget for the Institute, including the complete possible scope of utilization management, the transition of Phase 1 and Phase 2 work was assumed to take four years, culminating at the end of FY 2008. Therefore, the estimates, which are limited by the available data, do not include the complete scope of Institute responsibilities in FY 2008. In addition, these estimates do not reflect the budget and workforce associated with managing the Guest Investigator grant program.

For this estimate, the Institute workforce grows to approximately 1000 and the budget grows to approximately $200 million.

NASA intends to work through the next Program Operating Plan cycle to further refine the workforce and budget estimates associated with the establishment and transfer of work to the Institute. New, higher fidelity estimates will be provided in the implementation plan, to be completed and submitted to the Congress by mid-2003.

Summary

Guidance accompanying the FY 2001 and FY 2002 VA-HUD-Independent Agencies Appropriations Acts directed that NASA report to the Committees on Appropriations concerning various options for ISS utilization management. This report of the ISS Utilization Management Concept Development Study specifically addresses this direction, by describing the process employed by the NASA Team to develop and evaluate the ISS utilization management options, and outlining, in detail, the various options evaluated, included the recommended option. All options examined are described in Task 6 and the final candidate options are described in Task 7. A more detailed description of the final candidate options is provided in Appendix E.

After careful consideration of the final candidate options, NASA recommends proceeding with a competitive sourcing to contract with a Non-Profit Institute to lead ISS scientific, technology, and commercial (S/T/C) research.

Consistent with guidance accompanying the FY 2000-2002 NASA Authorization Act (P.L. 106-391), NASA intends to develop a detailed implementation plan for the recommended option of a Non-Profit Institute for submission to Congress by mid-2003. As a precursor to the implementation plan, this report provides:

(1)	description of the respective roles and responsibilities of the Administration and the non-government organization	Recommendation, App. E
(2)	proposed structure for the non-government organization	Task 6, Recommendation, App. E
(3)	statement of the resources required	Recommendation
(4)	schedule for the transition of responsibilities	Recommendation
(5)	statement of the duration of the agreement	Recommendation

Conclusion

The ISS Utilization Management Concept Development Study achieved its goals. The study succeeded in:

(1) capturing essential data;
(2) characterizing the scope and complexity of ISS utilization management;

(3) developing the fullest conceivable and feasible range of options;
(4) systematically analyzing all critical aspects of these options; and,
(5) evaluating the feasibility, practicality, responsiveness to the user community, and implications to NASA represented by the options.

Based on the foundation of previous studies and the findings of this study, the ISS Utilization Management Concept Development Team recommends that NASA proceed now with a NASA reinvention effort, in concert with a two-phase contracting approach to establish a Non-Profit Institute for ISS utilization. The NASA reinvention study has been initiated. The Phase 1 contract should proceed in an orderly fashion, in concert with the reinvention effort, and focus on science, technology, and commercial (S/T/C) leadership. If pursued in the future, a Phase 2 contract should maintain the focus on S/T/C leadership, and introduce responsibility for additional utilization management functions based on the results of NASA reinvention.

The potential bidder community will be informed of NASA's intentions and will be provided with an opportunity to submit feedback on the approach.

The Study Team believes that this implementation will efficiently and effectively enable NASA to achieve the promise of the ISS as a national and international asset, achieve the research mission of the ISS, and address the user community concerns. The user community will have more direct and substantive involvement in the research utilization process, joining NASA in a cooperative endeavor to fully realize the research potential of the ISS.

Appendix A – Previous Studies

In January 1999, the National Research Council, under the auspices of the Space Studies Board and the Aeronautics and Space Engineering Board, took steps to establish a task group to review alternative Institutional Arrangements for Space Station Research. They assessed the feasibility of employing a non-governmental organization (NGO) to manage ISS utilization. Their report recommended that NASA "should plan on establishing a NGO in three phases," a near term phase, a transition phase, and a long-term phase. The report also provided conclusions and recommendations on guiding principles related to the mission of the organization, structure and governance, location and staffing, relations with commercial users, budget authority, and specific roles and responsibilities.

NASA also contracted with Swales Aerospace Corporation, in June 1999, to study the characteristics associated with various forms of NGOs, explaining the advantages and disadvantages of each. A series of evaluative factors were developed to assist in measuring the relative effectiveness of each option in meeting NASA's objectives and Swales identified five business models that might be viable to manage ISS utilization. This study was not tasked to provide a recommendation.

In January 2000, NASA's Space Flight Program commissioned an independent ISS Operations Architecture Study from Computer Sciences Corporation. The objective of the study was to provide an independent recommendation for ISS operations architecture that included a justification and cost benefit analysis. The study also provided a strategy that indicated impacts to current government organizations and existing operations contracts. The study recommended formation of a "Space Station Utilization and Research Institute," which would deal directly with the station operator.

The fourth external study involved an ISS Payload Operations Concepts and Architecture Assessment Study (POCAAS), prepared by the Computer Sciences Corporation, in February 2002. The study assessed the current ISS concept of payload operations and the associated flight/ground architecture for efficiency improvements designed to solve problems identified by the user community.

After completing the external studies, NASA determined there was a need for an internal study to thoroughly define the comprehensive scope of functionality associated with ISS utilization management in advance of a decision on proceeding with an NGO. The first internal study provided a detailed definition of all ISS utilization and Research functions, followed by an assessment of those functions that potentially could be transitioned to an NGO, when that transition could occur, and what criteria should be used before work transitioned to an NGO.

Appendix B - ISS Utilization Management Baseline

Utilization management is currently performed by NASA civil service personnel and supported by contractor teams. Policy, strategic planning, and financial responsibility are held within the Biological ad Physical Research (BPR) Enterprise at NASA Headquarters. BPR Research Program Offices (RPOs) interface through the Division Offices for funding and discipline specific direction. Earth science, space science, and space flight RPOs report independently to their respective Enterprises.

Scientific research is acquired through NASA Research Announcements (NRA) or Announcements of Opportunity (AOs). Research proposals are received, reviewed, evaluated, and selected by NASA Headquarters or their designated agents, such as NASA-sponsored Institutes. NASA Field Centers support the evaluation process by providing science and engineering expertise for proposal review. Research proposal selections result in the award of Principal Investigator (PI) grants. Grant awards are made by the NASA Field Center or Institute assigned responsibility for the management and oversight of the award. ISS PIs are responsible for the definition of the investigation and analysis associated with experiments that are selected for implementation on the ISS. NASA Field Centers or Institutes are commonly the Payload Developer (PD) for the experiment flight hardware although in some instances the PI may also be the PD.

Following selection of a proposed research project as appropriate, research requirements and associated engineering assessments are defined and finalized. A Project Plan is signed between the Field Center and the Headquarters sponsor establishing technical, budget and schedule requirements for the project. Lead responsibility for the project then resides with the assigned Field Centers.

NASA provides access to the ISS for commercial research involving many diverse market segments. Commercial research is initiated through Commercial Space Centers, or through requests by companies through Space Act Agreements. Before being manifested for a flight assignment, all requests for flight are prioritized based upon product development evaluation metrics developed by the NASA Commercial Advisory Subcommittee. Before flight, the designated NASA Field Center verifies that all commercial research meets the commercial selection criteria established by NASA Headquarters. The Commercial Space Centers with their industrial partner, or the company holding the Space Act Agreement, have full responsibility for determining the research objectives, and developing the flight hardware.

NASA provides access to the ISS for technology research in support of each of the five major NASA Enterprises. Program formulation and funding responsibilities for technology activities resides within each of the appropriate Enterprise organizations. This ensures that technology considerations are closely coupled with mission decisions, that technologies are relevant to Enterprise needs, and that mechanisms are provided to transfer successful maturing technologies into operational systems. Individual projects of various types are selected through competitive solicitations involving multiple NASA Centers for oversight and teaming.

Utilization Mission Management of ISS is managed within the ISS Payloads Office (OZ) at Johnson Space Center. OZ is the research interface to the ISS and Shuttle Programs and the ISS International Partners. OZ has established an integration process with a documentation structure and support to the PD similar to past NASA Programs. The integration process incorporates requirements for multiple launch vehicle(s), carriers, and on-orbit laboratories into one template. Operations products are developed by the individual PDs. The responsibility for development of operations integration products is delegated to the payload facility or payload rack PD. PDs and RPOs interface with OZ for the integration of payloads and for negotiating manifesting and resource allocations. Flight and ground safety functions are separate from OZ and HQ, and are maintained as separate offices for both Shuttle and ISS.

Appendix C – Strategic Vision for ISS Utilization

The ISS – our human outpost in space – continues to bring nations together for the benefit of life on Earth – and beyond.

This world-class orbiting international laboratory supports a continuum of research discoveries from a balanced and diverse mix of advanced scientific and technological research, all of which require the unique environment of space. Research aboard the ISS can be expected to address many spheres of endeavor, including, but not necessarily limited to the support of:

- Basic and applied research in the biological and the physical sciences: The ISS is enabling significant advances in understanding the role that gravity plays in biological and physical systems;
- Research and testbeds to develop the knowledge, technologies, procedures and protocols necessary to support space exploration: The ISS is serving as an exciting gateway to new frontiers in human space exploration, allowing us to explore the unknown, to understand our world, and to apply that knowledge for the benefit of all;
- Commercial research and endeavors: The ISS is enhancing U.S. economic competitiveness and creating new commercial enterprises;
- Space Science and Earth Science research: The ISS, as an observing platform which is routinely maintained and enhanced in response to changing technologies and research capabilities, is complementing our inventory of free flying observatories, all of which serve to enhance our knowledge of the Earth, our Solar System and the Universe; and,
- Educational endeavors: The ISS serves as a virtual classroom in space to the benefit of educators and students alike, with educators and students actively participating in research conducted on Station.

The specific goals and objectives associated with ISS utilization will be aligned with, and responsive to, the strategic plans of the sponsors of research aboard the ISS.

Operations aboard the ISS are conducted in a manner that is responsive to international agreements, efficient in terms of maximizing the laboratory's research potential, and that fully realized the value of having crew aboard to conduct and participate in research.

Investment in advanced technologies, coupled with the planned change out of ISS systems, experiments and experiment support systems is allowing for a timely and predictable progression of capabilities in response to user community needs.

A clearly defined set of performance metrics which track the ability of the ISS to meet user requirements has been established and is monitored on a regular basis. The appropriate continuous process improvement mechanisms are in place to achieve increased research utilization opportunities, output, and outcome where possible, and to deal with negative trends in a timely manner.

Appendix D - Definition of 21 Functions

Function 0. **Defining and Implementing Policy and Strategic Plans.** This function includes the definition, development and implementation of public policies and strategic plans related to ISS research and utilization. Specific functions include organization and execution of boards, panels, working groups, and advisory committees involved in the definition of research plans and processes; definition, development and coordination of national and international cooperation; and the organization of forums for planning development of research programs on a strategic global scale within public policy. Policy and plans implementation is distributed across both headquarters and field center organizations.

Function 1. **Management of Research Utilization.** This function represents the management of research utilization on the ISS. It includes strategic and tactical implementation of management functions.

Function 2. **Preparing and Allocating Budgets.** This function includes long-range and fiscal budget formulation, justification, and budget execution of ISS research and utilization. Specific functions include budget preparation, legislative consideration and approval, budget execution oversight and reporting, and evaluation of performance.

Function 3. **Selecting and Prioritizing Research.** This function includes the announcement of research opportunities; operation of non-advocate peer panels in science and corresponding review bodies for technological or commercial projects; programmatic or other evaluations associated with the selection process; and selection/prioritization of experiments, tests, demonstrations, or other research activities on the ISS. This function includes both the investigations and the associated payload manifests to the ISS at the corresponding levels of detail associated with headquarters and field center prioritization and queuing processes. The prioritization function includes determination of national and agency priorities for utilization of the ISS, inclusive of commercial initiatives.

Function 4. **Establishing Payload/Experiment Requirements and Feasibility.** This function defines and documents the payload/experiment requirements necessary to fully accomplish a specific set of research objectives and/or goals. These requirements must be written in sufficient detail to determine the feasibility of successfully completing that investigation with: (1) existing flight experiment hardware; (2) some modification of existing flight experiment hardware; or, (3) new flight experiment hardware concepts. In limited cases, these requirements are written to establish the feasibility of providing the

capabilities necessary to accomplish a particular range and/or class of experiments through the use of a core facility and experiment unique payloads. When these requirements have been verified as sufficient, they are documented and entered into a program/project configuration management system. This definition covers the Formulation Phase of a project.

Function 5. **Developing Cost, Schedule and Risk Assessments.** This function includes the development of estimates of the costs for Ground and/or Flight Systems needed to satisfy ISS research requirements as well as estimates of when these systems will be available for deployment and operations. These cost and schedule assessments can involve estimates for accomplishing the research objectives through the use of existing systems, the modification of existing systems, or the development of new systems. NASA will use these estimates during ISS research planning and during the process of approving new system developments. The fidelity of the cost and schedule estimates will be characterized through an assessment of the risks involved in providing the needed systems within the cost estimate and by the estimated deployment date. NASA's need for high fidelity cost and schedule estimates may require risk reduction through technology development/demonstration efforts as a part of the function. This may include work necessary for NASA to estimate pricing and evaluate commercial proposals. This definition covers the Approval Phase of a project.

Function 6. **Developing and Qualifying Flight Research Systems.** This function represents the design, development, test, integration and evaluation of flight research equipment (i.e. hardware and software) used in the transportation, accommodation or operation of research payloads on the ISS, including the preparation of all necessary documentation, configuration control and conduct of qualification and acceptance/certification testing and acceptance procedures, protocols and processes to ensure that all requirement are met. Flight research equipment refers to subrack payloads, facilities, multi-use equipment, etc. For facilities, the activities described below will often include an integrated effort where the facility developer must include and assess inputs from individual subrack payloads to form a part of their facility effort.

Function 7. **Maintaining and Sustaining Flight Research Systems.** This function represents the maintenance, operations and sustaining engineering of flight research systems (e.g. facility payloads, EXPRESS Racks, EXPRESS Pallet) through upgrades, replacement, or spares. It represents the recurring costs associated with Function 6.

Function 8. **Developing Ground Systems.** This function represents development of all multi-user, discipline-specific and experiment-unique ground systems necessary to support the successful operation of the flight research systems. It includes all associated systems, subsystems, components or other related items (e.g. communications, data processing, data analysis equipment, GSE, training hardware and simulators) necessary to the ground program. This function excludes the development of ground systems that also serve non-ISS programs and projects. This function represents those major systems that have a non-recurrent cost.

Function 9. **Maintaining and Sustaining Ground Systems.** This function represents the maintenance, operations, and sustaining engineering of multi-user, discipline-specific and experiment-unique ground systems or equipment (e.g. communications, data processing, data analysis equipment, GSE, training hardware and simulators). It represents the recurring costs associated with Function 8. This function excludes maintaining and sustaining ground systems that also serve non-ISS programs and projects.

Function 10. **Constructing Ground Facilities.** This function represents major acquisitions in terms of buildings, laboratories and test facilities, including initial outfitting of capital equipment (e.g. overhead cranes, lab benches, autoclaves, hoods) and furniture, associated with multi-user and discipline-specific ISS research and utilization. This function may include construction of ISS-specific portions of facilities that also serve non-ISS programs and projects and represents major acquisitions that have a non-recurrent cost.

Function 11. **Maintaining Ground Facilities.** This function represents the maintenance, operations, and sustaining engineering associated with buildings, laboratories, and test facilities for multi-user and discipline-specific ISS research and utilization (e.g. Control Centers, Telescience Centers). This function may include maintaining ISS-specific portions of facilities that also serve non-ISS programs and projects. It represents the recurring costs associated with Function 10.

Function 12. **Certifying Safety of Research Flight and Ground Systems.** This function represents the assessment of payload safety at the system, subsystem, component, and sample/specimen levels, including the safety of procedures, protocols and processes associated with payload, or experiment, transportation, accommodation or operations. This function includes safe design, manufacture, verification, and operation. It also includes preparation and presentation of safety data packages, including integrated safety data packages for a compliment of payloads or experiments. The responsibility for final approval of safety will remain with NASA.

Function 13. **Managing Missions and Allocating Services.** This function includes the definition and commitment of services between the end-user, or payload developer, and the Agency in order to ensure timely production of all user hardware, software and documentation deliverables in accordance with pre-agreed milestones. This function also includes the planning, integrating, and scheduling and of all user-related activities necessary for successful multilateral utilization of the space station in flight or on the ground in pre and post-flight periods. User related activities include: (1) transportation assignments to launch vehicles; (2) physical accommodation assignments to the space station user accommodation elements; and, (3) operating period assignments on the space station with corresponding resource allocations for crew time, energy, data transmission and any unique resources specific to individual user activities. In order to plan, integrate and schedule these critical user activities efficiently and effectively on a multilateral basis, the mission management function is also responsible for directing the orderly performance and timely completion of all remaining principal functions which are on the critical path to user transportation, accommodation and operations. In cases where joint program commitments are required among the station partners in order to transport, accommodate, or operate user elements, this activity includes the negotiation of joint program documents and management of the implementation phase.

Function 14. **Integrating User Missions - Analytical.** The purpose of analytical integration to ensure safe and functional hardware and software interfaces. The 'user' side of the interface may be an experiment, a payload, or a payload complement. The 'operator' side of the interface may be the crew, a rack, a pallet, an ISS laboratory module, an exposed facility, launch vehicle(s), ground operations center(s); any of which may belong to one or more International Partners. Functions necessary to ensure safe and functional interfaces include: negotiation of Interface Control Documents, development of interface verification plans, certification of interface verification procedures, analyses and/or testing to support interface verification, analyses and/or testing to support verification, safety and compatibility of a complement of payloads, development and certification of complement-unique software configurations, development of operational constraints, and real-time support for anomaly resolution.

Function 15. **Integrating User Missions - Physical.** This function includes the physical buildup, testing, validation/ verification of functional interfaces, specialized science processing, and integration of experiments, payloads, or payload complements during the ground processing phase in preparation for launch to the ISS. This function

also includes physical de-integration of experiments and payloads at the landing site.

Function 16. **Integrating User Missions - Operational.** This function includes the near real-time activity conducted at payload and station operations centers. This includes short term planning and replanning, contingency planning, and responses to unplanned events associated with or otherwise affecting the ISS research program at all levels. Payload training activities are also included in this function.

Function 17. **Conducting Research & Analysis and Disseminating Results.** This function represents the work of the principal investigator in scientific endeavors, or the project investigator in technological or commercial endeavors, that is directed toward the achievement of research objectives. The investigator specifically leads the development of requirements and objectives for the research, undergoes appropriate research review, is involved in the experiment procedure development and on-board real-time research operations, conducts analysis of the data and/or samples, prepares operational reports, compares results to objectives, submits research reports, provides input to the archiving process, and participates in research conferences to report and discuss results to the research community.

Function 18. **Educating and Reaching Out to the Public (including industry).** This function includes the development, dissemination and evaluation of information to the public through a wide variety of methods in order to educate and broaden awareness of the ISS program and its associated benefits and to inspire the next generation of explorers.

Function 19. **Recommending ISS Pre-Planned Product Improvements.** This function represents the user community recommendations and priorities for improvement of ISS productivity through upgrades, changes, or additions to the ISS spacecraft systems, elements, and/or processes which enhance the quality or quantity of user accommodations or operations, this supports the broader P^3I objectives of the Program.

Function 20. **Managing Archival of Research Samples, Data and Results.** This function represents the management of ground archiving of research products in accordance with established processes for future use in an accessible manner that ensures preservation of information. The function also includes facilitating and enabling the distribution of results. Research samples, data and results that are proprietary in nature will continue to be maintained by the industrial sponsor.

Appendix E – Summary of Final Candidate Options

The following summary outlines the final candidate options (Reinvent, Institute, and Federally Funded Research and Development Center (FFRDC)), along with their major strengths and weaknesses:

Reinvent NASA: The Reinvent NASA Option, as originally developed by the NASA Team, maintains utilization management in NASA and centralizes all activities associated with ISS and Shuttle microgravity flight research into one NASA Enterprise, separate from their current organizational structure. Research elements such as research selection, ground research, and research flight hardware development are retained in the respective research Enterprises. The flight research community requirements are central to this option. In this option, a major capability required to address research needs is an integrated flight research strategy across NASA, other government agencies, and platforms. In order to achieve this, one organization is cognizant of the queue of flight experiments; knowledgeable of multiple platforms, their capabilities, and their schedules; responsible for assuring flight of all experiments as opposed to competing for carrier space; consistent in requirements requested of the user community for flight; and works for the good of all research versus that of a platform specific community.

To address the leadership aspects of the S/T/C communities, the Reinvent NASA option provides focus on the user community through two teams, the Customer Focus and the Smart Integration Teams. These teams serve the user community and are focused on attracting, satisfying, and sustaining their interest as well as responding to the needs of the researchers. Another strength and methodology identified to achieve "user identity" is the establishment of a Shuttle/ISS Research Council comprised of rotating individuals under Inter-governmental Personnel Act (IPA) agreements who represent the user community. Rotations provide the opportunity to achieve maximum representation from all research disciplines and the S/T/C arenas, while simultaneously enhancing user identity with the teams and processes involved in implementing payloads on ISS.

The weakness of the Reinvent option is that a perception exists within the user community that the necessary change cannot be implemented within NASA, due either to bureaucracy or a lack of priority. As NASA retains the work associated with utilization management, the reorganization may be perceived as non-responsive to the user community. These perceptions may be further reinforced by the recentness of organizational changes in NASA. The Biological and Physical Research (BPR) Enterprise, where utilization management currently resides, became a separate entity from the Human Exploration and Development of Space (HEDS) Enterprise only two years ago. Funding responsibility was also only recently moved to the BPR Enterprise. It could be difficult to further redefine BPR and HEDS, as required by this option.

Lack of direct jurisdiction by the research Enterprises over the research flown on every ISS increment is also seen as a weakness within the Reinvent NASA option. Lastly, continuing to maintain utilization management within the Agency for the life of the ISS does not free civil servants for future Agency initiatives.

ISS Research Institute: The ISS Research Institute (ISSRI) would be an organization with the primary role of providing intellectual leadership and a centralized focus for utilization of the ISS for science, technology and commercial (S/T/C) purposes. The establishment of the ISSRI would demonstrate NASA's commitment to the ISS as a world-class research facility and send a clear message of NASA's commitment to the S/T/C user community.

The ISSRI would facilitate the access by the scientific and industrial communities to the ISS and provide a consolidated, strong advocate for the user community to effect change in the utilization systems and processes. It would also provide a central, knowledgeable focal point for the user access to ISS, and a consistent approach for ISS education and outreach activities under NASA's strategic guidance.

The ISSRI would be responsible for the creation of Guest Investigator (GI) programs. These programs could consist of the following:

a) After the intended Principal Investigator program had been completed with specific flight hardware, NASA may elect to have the Institute manage that hardware, including the necessary sustaining engineering. The ISSRI would develop new ways to implement research with the existing hardware, and/or develop improvements to enable new research, potentially through new technology and extended scientific constituencies to be selected through NASA research announcements.
b) The Institute would focus on developing the constituencies for cross-disciplinary use of existing research facilities.
c) The Institute would create and manage a program to utilize available (or set-aside) ISS resources for discretionary research and/or educational benefit. One component of this program would be educational payloads with associated ground-based activities. Another component would be commercial or peer-reviewed fundamental research investigations, already selected, that can be performed at the option of the crew on a "job jar" basis. These may be new investigations or enhancements to existing investigations which are not required to be done at a specific time or on a specific increment.

The pivotal strengths of the ISSRI include its independent leadership for, and representation of, the entire S/T/C community. There are well-established precedents for NASA research institutes. The leadership stature and ability of the Institute staff to conduct research enhances recruitment and the ability to retain the "best and brightest." NASA ISS user Enterprises would retain control of strategic ISS utilization priorities and direction through a Board of Directors and the contract vehicle. The control of the full utilization budget would also remain with NASA through the ISSRI contract.

This option would allow maintaining a competency balance between NASA and the ISSRI, and it would have a relatively small impact on the civil service workforce. Additionally, the contract vehicle allows for orderly termination of the ISSRI role at the end of the ISS utilization life.

The weakness of an institute resides in the fact that providing leadership to the whole S/T/C spectrum and the multiple science disciplines could be a difficult task. The ISSRI participation in research selection and the ability of the staff to propose to conduct research introduces the potential for conflict of interest. Delegating utilization manifesting to the ISSRI might negatively impact current efforts to consolidate and streamline Shuttle and ISS manifesting activities. Lastly, the ISSRI cannot negotiate and approve agreements directly with the International Partners.

Mitigation strategies for the weaknesses identified for the recommended Non-Profit Institute were considered. The selection process for the ISSRI would need to emphasize leadership capabilities for the appropriate science disciplines', technology, and commercial research. With respect to potential conflicts of interest, other Non-Profit Institutes have effectively avoided such conflicts, and NASA would need to use those institutes as models while clearly establishing strict conflict of interest criteria to be reviewed during periodic evaluation of the Institute. The ISSRI role would be introduced into the redefinition of the manifesting process during the development phase in order to ensure a coordinated and cohesive process results. Finally, while ISSRI cannot negotiate and approve agreements directly with the International Partners (IP), they can provide valuable input to NASA on salient IP issues.

Federally Funded Research and Development Center: An FFRDC could bring together the expertise and viewpoints of government, industry, and academia to solve the complex managerial and technical issues associated with the optimum utilization management and use of the ISS. Traditionally, an FFRDC can perform three classes of work: scientific research and analysis, systems development, and systems acquisition.

To ensure objectivity and technical excellence, an FFRDC for ISS utilization management would be organized as an independent, not-for-profit entity with certain limitations and restrictions on its activities. Specifically, the FFRDC would be structured to avoid potential conflicts of interest by: (1) having NASA retain final selection of proposals and their associated grant funding; and, (2) limiting the payload development role to providing standardized customer integration and support services, with no involvement in hands-on research. These limitations, coupled with its not-for-profit status, permit an FFRDC to employ a degree of access and long-term perspective not shared by commercial contractors.

The strengths of the FFRDC result from its unique position to perform S/T/C leadership and ISS utilization. Due to its diversity in expertise, the FFRDC would be able to effectively lead and act as an advocate for the entire S/T/C community. The FFRDC model provides a single point of entry for users into the ISS process, making the NASA process transparent to ISS users. NASA would retain payload development to permit the various NASA Centers to retain competencies.

The FFRDC would be responsible for maintaining and sustaining existing flight research systems since it is anticipated that the majority of future customers will use existing

equipment. The FFRDC could partner with NASA to enhance and to standardize payload development, to maintain and sustain existing payload facilities, and to provide tactical utilization. This partnership arrangement would allow the FFRDC to participate at all levels of NASA from the Space Station Utilization Board that establishes strategic planning to NASA Centers involved in operations.

The weaknesses related to an FFRDC include the difficulty with transition, since it would entail many of the functions comprising ISS utilization. Establishing an FFRDC would create the greatest number of additional interfaces, since it assumes the largest number of functions. Accompanying changes to streamline functions remaining with NASA would be necessary to effect the improvement within the system. There is also a perception that the FFRDC would be unable to attract the best and brightest, due to the lack of opportunity to conduct hands-on research.

Appendix F – Evaluation Criteria

I.a Performance Factors – Safety

Safety Assurances - The organization has the appropriate levels of approval authority and planning involvement (internal Agency representation, definition of budget requirements, management accountability, process control, and improvement implementation) to assure the highest priority on the safety of all human life and the protection of national and international assets while remaining user mission focused in facilitating utilization of ISS.

I.b Performance Factors – Technical

Leadership Commitments - The organization can effectively provide the broadest range of advocacy, conflict-free integrity (perceived and real), and the highest quality research services to the user and stakeholder communities in fulfilling the overall ISS utilization objectives while assuring the accomplishment of the specific goals, objectives, and requirements within each of the three research areas of endeavor:
a. **Science**
b. **Technology**
c. **Commercial**
d. **Integrated Science, Technology, & Commercial (S/T/C)**

Strategic Focus - The organization is responsible for, and structured to, achieving and maintaining focus on excellence in ISS Utilization as its highest priority and has its goals and objectives aligned to the strategic plans of the S/T/C user community and sponsoring research entities, while also being timely, flexible and adaptable in its ability to respond to changing research needs.

Optimized Use of Access and Resources - The organization has the capability to optimize the use of current and future available space access and ISS resources. This will support the highest priority conduct of research on a world-class international facility. This includes authority, position of influence, resources, and appropriate external organizational interfaces to advocate, negotiate, and secure commitments for the user communities. Examples of necessary and dependable access resources include the frequency, timeframe, and location of launch opportunities; vehicle ascent and descent resource allocations; and ISS resource allocations and contingency accommodations.

Shorter Time to Enable Discovery - The organization has a mission focus that establishes the highest priorities to providing stable research funding commitments and efficient outcome driven user centric processes, including research selection and multiple flight approval as appropriate, in order to reduce the end-to-end life-cycle time of a payload.

Customer Focus - The organization is structured to effectively involve the S/T/C user community in all phases of planning, designing, implementing, conducting, and

evaluating utilization of the ISS; foster trusted confidence and greater external involvement of the user community in ISS utilization; and focus on responding to the voice of the customer in its ability to simplify and streamline the processes associated with ISS utilization.

Knowledge - The organization can achieve maximum dissemination of appropriate research results to all for use in generating knowledge and application to further research, as well as education and outreach.

I.c Performance Factors – Business

International Involvement - The organization has the authority, resources, and accepted international recognition to not only comply with international commitments but to also leverage international assets though partnerships, barter agreements and other contract arrangements in achieving maximum effective ISS utilization. The organizational interface complexities in initiating opportunities (directly and indirectly) and in performing these responsibilities should be as simple as possible and provide high accountability for results to NASA, the national S/T/C user communities, and the international research communities.

Quality of Human Resources - The organizational structure, size, opportunities, positions of influence, incentives and culture can attract the "best and brightest" to fulfill the broad nature of the leadership, advocacy, technical skills, management expertise, business acumen practices, innovative improvements, and customer oriented attitudes for each the three research endeavors.

Responsiveness - The organization can align its budget and staffing, and provide the management focus and flexibility in its processes to be responsive to user requirements and to achieve increased research utilization opportunities, output, and outcome through continuous process improvement mechanisms and lessons learned.

Performance Accountability - The management option can provide leadership values and performance expectations that are user-focused, aligned with the available resources, and consistent with all organizational commitments. The management processes, lines of authority, ownership of responsibilities, and process improvement actions should reflect maximum organizational accountability for performance in accomplishing and improving the desired user outcomes.

Integrity - The organization can efficiently provide stewardship of public monies and assets, selection processes, and custodial responsibilities for intellectual properties and fulfillment of commitments (users, stakeholders, and partners).

Interface Responsibilities - The organization can effectively interface with and/or perform the functions that are inherently or appropriately governmental in nature with minimum implementation complexity and no negative impact to the overall governmental responsibilities of NASA.

Financial Expenditure - The organization is structured to optimize implementation and sustaining costs, and can provide certainty and confidence in the commitment of resources required to produce the best value to the researcher, over the life of the research project and processes.

Funding and Support Advocacy - The organization should be capable of effectively advocating and acquiring viable, sustainable funding resources, including capital investments, broadening the ISS user community, obtaining and maintaining external relationships, and clearly communicating the relevance of outcomes and the resource requirements necessary to proactively support the ISS S/T/C user communities.

II. Agency Implications

Transition - The transition plan mitigates risks to NASA and the organization, is logical and timely, minimizes impacts to ongoing operations and existing contracts, and contains minimal disruption to existing interfaces and agreements.

Establishment – The establishment of the entity considers the complexity of the implementation, the requirement for approval/legislation outside of NASA, the predictability of the outcome, the time needed for establishment, the longevity of the arrangement, and the ability to recompete or sever the arrangement.

Facilities - The organization has the ability to obtain the necessary facility resources to perform assigned functions and maximize the accessibility, availability, and overall cost effectiveness in the use of the required facility resources - including those that are owned and/or operated by the government.

Control - The organization has an appropriate level of control for managing the designated functions and will respond to NASA direction as required to carry out its responsibilities.

NASA Human Capital - The implementation of the organization allows NASA to define a full suite of human capital strategies and implement the tools necessary to address potential adverse impacts on NASA employees, the degree of complexity of the strategies and tools, and the effort necessary for this implementation is considered to be reasonable for NASA to undertake.

Competencies – The competency strategy achieves a balanced result between staffing critical competencies of the new organization and NASA, and recognizes those competencies that NASA must retain and those for which it relies on industry, academia and others to provide.